

101CSC Pty Ltd ATF 101 CSC Sub Trust c/- Bayley  
Stuart Capital Pty Ltd

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101 Cremorne Street, Cremorne

Wind Impact Assessment



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30N-23-0049-TNT-58422-4

5 July 2024



## Executive Summary

[REDACTED] commissioned Vipac Engineers and Scientists Ltd to prepare a statement of wind effects for the ground level areas adjacent to the proposed development at **101 Cremorne Street, Cremorne**. This appraisal is based on Vipac's experience as a wind-engineering consultancy.

Updated drawings of the proposed development were provided by **CHT Architects** in **June 2024**.

The findings of this study can be summarized as follows:

### With proposed design:

- Wind conditions in the ground level footpath areas and access ways would be expected to be within the **walking** comfort criterion.
- the main entrances would be expected to be within the **standing** comfort criterion;
- The seated areas at the southwest corner would be expected to fulfil **sitting** criterion.
- The terraces and balconies would be expected to be within the recommended **standing** comfort criterion at most areas.
- The wind conditions are expected to fulfil **safety** criterion.

As a general statement, educating occupants about wind conditions at open terrace/balcony areas during high-wind events and fixing loose, lightweight furniture on the terrace are highly recommended.

The assessments provided in this report have been made based on experience of similar situations in Melbourne and around the world. As with any opinion, it is possible that an assessment of wind effects based on experience and without experimental validation may not account for all complex flow scenarios in the vicinity.

Vipac recommends a wind tunnel study be conducted at the detail design stage to quantify the wind conditions and determine the proper wind control measures wherever necessary.

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## 1 Introduction

Vipac Engineers and Scientists has been commissioned by **101CSC Pty Ltd ATF 101 CSC Sub Trust c/- Bayley Stuart Capital Pty Ltd** to carry out an appraisal of the pedestrian wind effects at the ground level of the proposed development at **101 Cremorne Street, Cremorne**.

Strong winds in pedestrian areas are frequently encountered in central business districts of cities around the world; including Sydney, Melbourne and Brisbane. Wind characteristics such as the mean speed, turbulence and ambient temperature determine the extent of disturbance to users of pedestrian areas. These disturbances can cause both comfort and safety problems and require careful consideration to mitigate successfully.

The proposed development is a 12-storey office building with a roof height of 53.7 m from the street level. The site is bounded by Kelso Street to the north, Cremorne Street to the west, and existing developments to the south and east. A satellite image of the proposed development site and the northern elevation of the building are shown in Figure 1 and Figure 2, respectively.

This report details the opinion of Vipac as an experienced wind engineering consultancy regarding the wind effects in ground level footpath areas adjacent to the development as proposed. No wind tunnel testing has been carried out for this development at this stage. Vipac has carried out wind tunnel studies on a large number of developments of similar shape and having similar exposure to that of the proposed development. These serve as a valid reference for the prediction of wind effects. Empirical data for typical buildings in boundary layer flows has also been used to estimate the likely wind conditions on the ground level areas of the proposed development [2] & [3].

Drawings of the proposed development were supplied to Vipac by **CHT Architects** in **June 2024**. A list of drawings supplied is provided in Appendix C of this report.

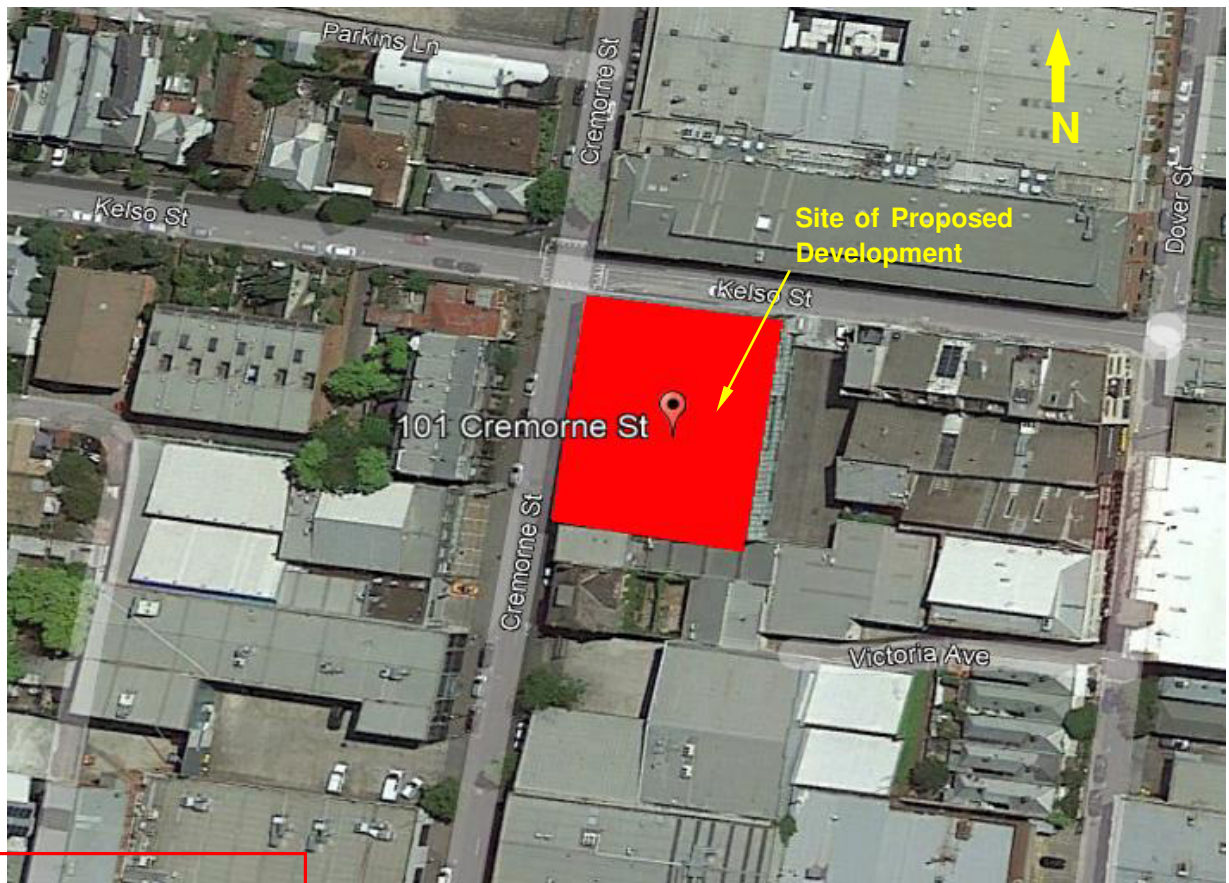


Figure 1: Aerial view of the proposed development site.

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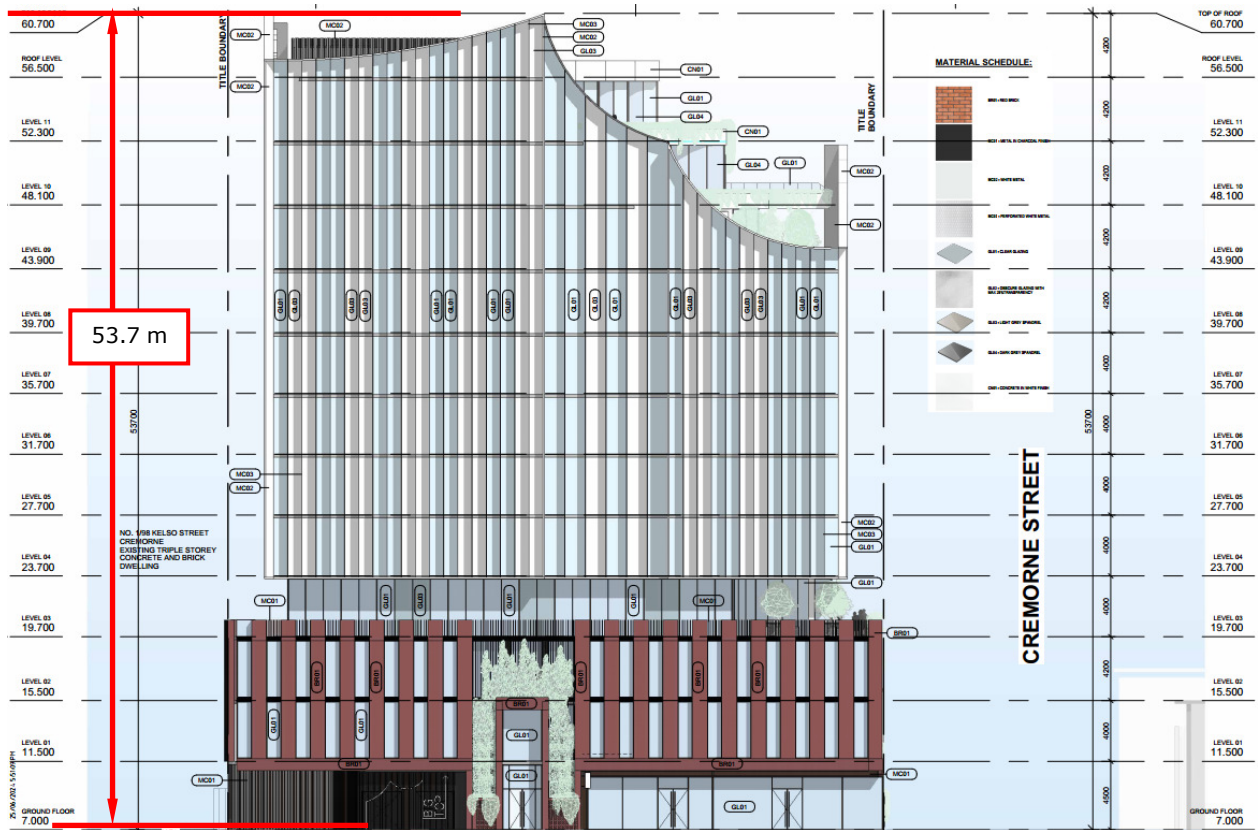


Figure 2: North elevation of the proposed development.

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## 2 Analysis Approach

In assessing whether a proposed development is likely to generate adverse wind conditions in ground level footpath areas, Vipac has considered the following five main points:

- The exposure of the proposed development to wind;
- The regional wind climate;
- The geometry and orientation of the proposed development;
- The interaction of flows with adjacent developments; and
- The assessment criteria determined by the intended use of the areas affected by wind flows generated or augmented by the proposed development.

The pedestrian wind comfort at specific locations of ground level footpath areas may be assessed by predicting the gust and mean wind speeds with a probability of 0.1% and 20% expected at that location. The location may be deemed generally acceptable for its intended use while gust and mean wind speeds are within the threshold values noted in Section 2.5. Where Vipac predicts that a location would not meet its appropriate comfort criterion, the use of wind control devices and/or local building geometry modifications to achieve the desired comfort rating may be recommended. For complex flow scenarios or where predicted flow conditions are well in excess of the recommended criteria, Vipac recommends scale model wind tunnel testing to determine the type and scope of the wind control measures required to achieve acceptable wind conditions.

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## 2.1 Site Exposure

The proposed development is located on a relatively flat terrain. The site is surrounded within an approximately 3 km radius predominately by low to mid-rise developments with Melbourne CBD to the far northwest. A satellite image showing these site surroundings is shown in Figure 3.

Considering the immediate surroundings and terrain, for the purposes of this study, the site of the proposed development is assumed to be within Terrain Category 3 for all wind directions (Figure 3).

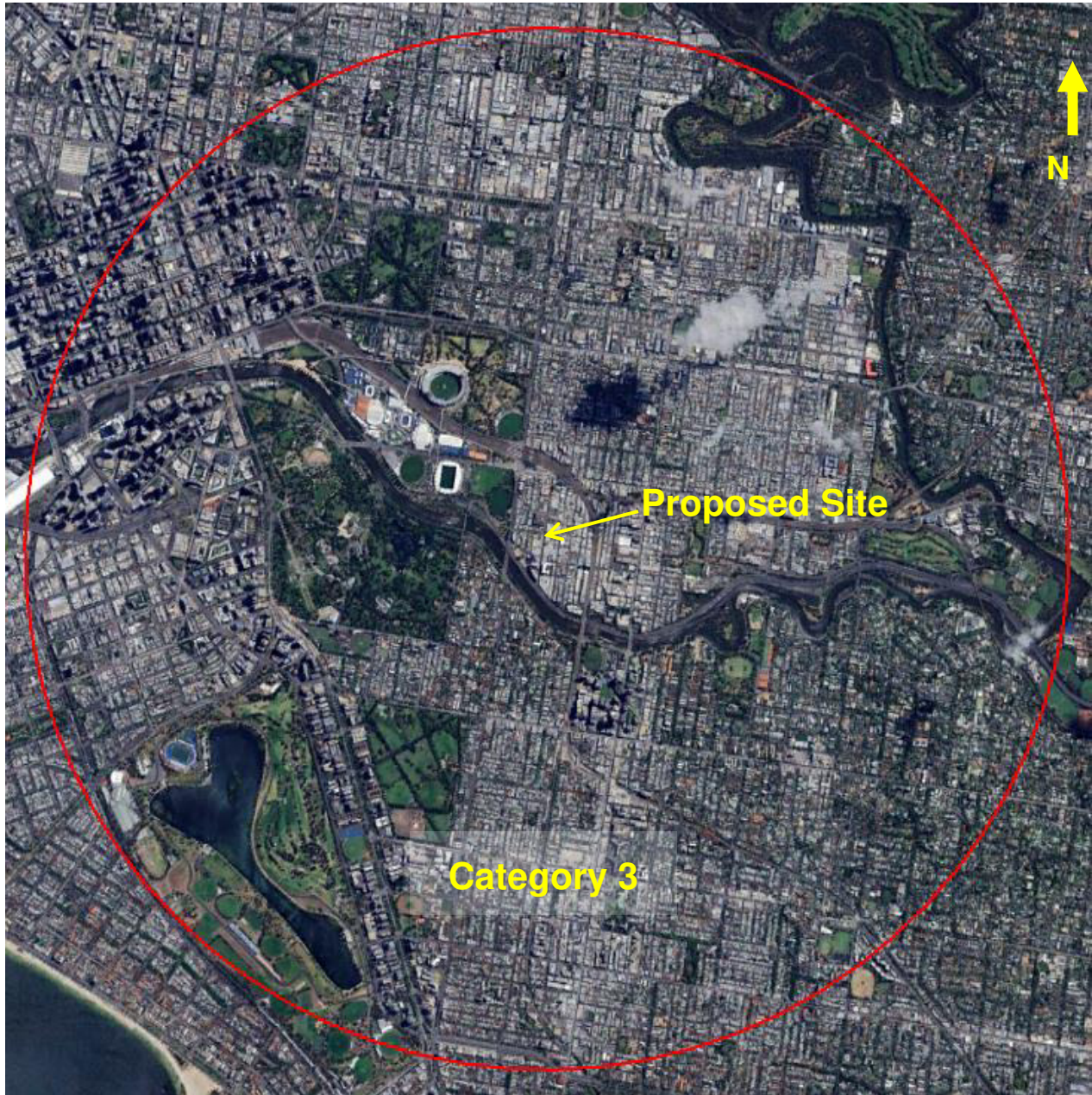


Figure 3: Assumed terrain categories for wind speed estimation.

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## 2.2 Regional Wind Climate

The mean and gust wind speeds have been recorded in the Melbourne area for over 30 years. This data has been analysed and the directional probability distribution of wind speeds has been determined. The directional distribution of hourly mean wind speed at the gradient height, with a probability of 0.1% of time and 20% of time exceeded are shown in Figure 4. The wind data at this free stream height is common to all Melbourne city sites and may be used as a reference to assess ground level wind conditions at the site.

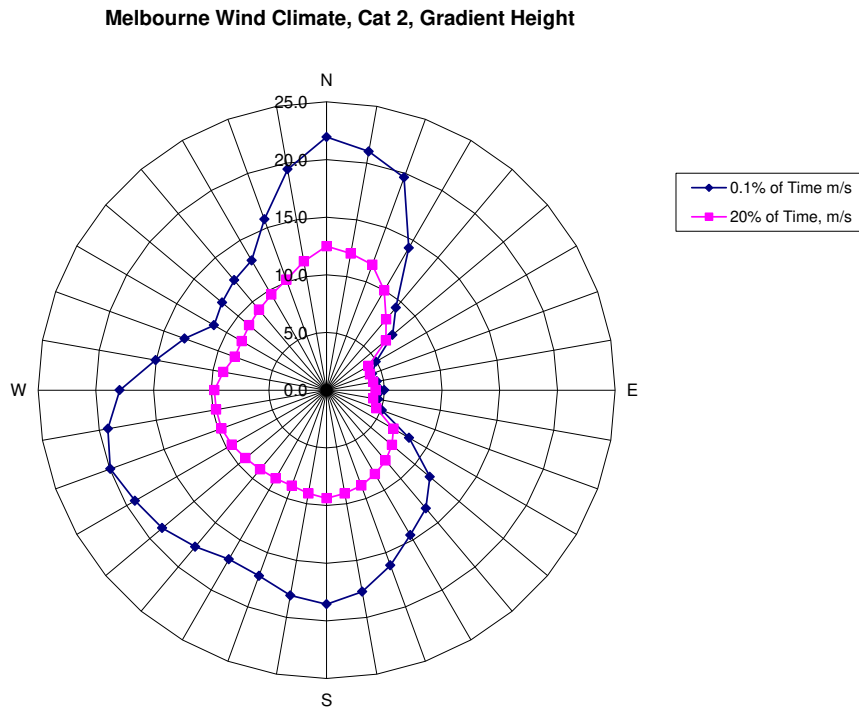


Figure 4: Directional Distribution of Mean Hourly Wind Velocities (m/s) for 0.1% and 20% exceeded at Gradient Height for Melbourne.

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## 2.4 Flow interactions with Adjacent Developments

The immediately adjacent developments are shown in Figure 6. At ground level, the site is exposed to direct winds from the northerly directions channelling along Cremorne Street. The building is oriented such that adverse impacts from corner acceleration of northerly and westerly winds is expected at ground level NW corner. The development is taller than the surrounding buildings and so is exposed to winds from all directions at the upper levels.



Figure 6: Immediately adjacent surroundings and their approximate number of floors (F).

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## 2.5 Assessment Criteria

The following wind comfort criteria detailed in Table 1 were applied in this study.

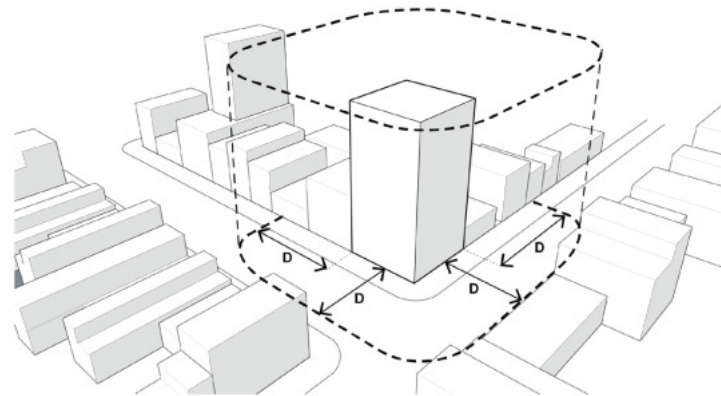
Table 1: Wind Comfort Criteria as per Clause 58.04-4

Unsafe	Comfortable
Annual maximum 3 second gust wind speed exceeding <b>20m/sec</b> with a probability of exceedance of 0.1% considering at least 16 wind directions.	Hourly mean wind speed or gust equivalent mean speed from all wind directions combined with probability of exceedance less than 20% of the time, equal to or less than:  <b>3m/sec</b> for sitting areas (outdoor cafés) <b>4m/sec</b> for standing areas (window shopping, queuing) <b>5m/sec</b> for walking areas (steady steps for most pedestrians)

This criterion specifically calls for the safety criterion to be used to assess infrequent winds (e.g. peak event of  $\leq 0.1\%$  of the time); and the perceived pedestrian comfort to be assessed based on frequently occurring winds (e.g. winds that occurs 80% of the time).

In Table 1, the mean wind velocity is defined as the maximum of hourly mean or gust equivalent mean ( $Gust/1.85$ )

This criteria specifies that safe and comfortable wind conditions must be achieved in publicly accessible areas within a distance equal to half the longest width of the building measured from all facades or half the overall height of the building, whichever is greater, as shown in Figure 7.



ASSESSMENT DISTANCE D = GREATER OF:  
 L/2 (HALF LONGEST WIDTH OF BUILDING) OR  
 H/2 (HALF OVERALL HEIGHT OF BUILDING)

Figure 7: Assessment distance.

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### 2.5.1 Use of Adjacent Pedestrian Occupied Areas & Recommended Comfort Criteria

The following table lists the specific areas adjacent to the proposed development and the corresponding recommended criteria.

*Table 2: Recommended application of criteria*

<b>Area</b>	<b>Specific location</b>	<b>Recommended Criteria</b>
Public Footpaths, Access ways	Along Kelso Street and Cremorne Street (Figure 8)	Walking
Building Entrances	Main building entrances at Kelso Street and Cremorne Street (Figure 8)	Standing
Terraces	Located on the podium roof and Levels 9 - 11 (Figure 9 - Figure 12)	Walking (See discussion below)

### 2.5.2 Terrace / Balcony Recommended Criterion Discussion

There are Terraces located up the height of the development. Vipac recommends as a minimum that balcony/terrace areas meet the criterion for walking since:

- these areas are not public spaces;
- the use of these areas is optional, and only intended to be used on fair weather days with calm winds;
- many similar developments in Melbourne and other Australian capital cities experience wind conditions on balconies and elevated deck areas in the vicinity of the criterion for walking.

In this study, most terrace areas are assessed against the more stringent standing criterion.

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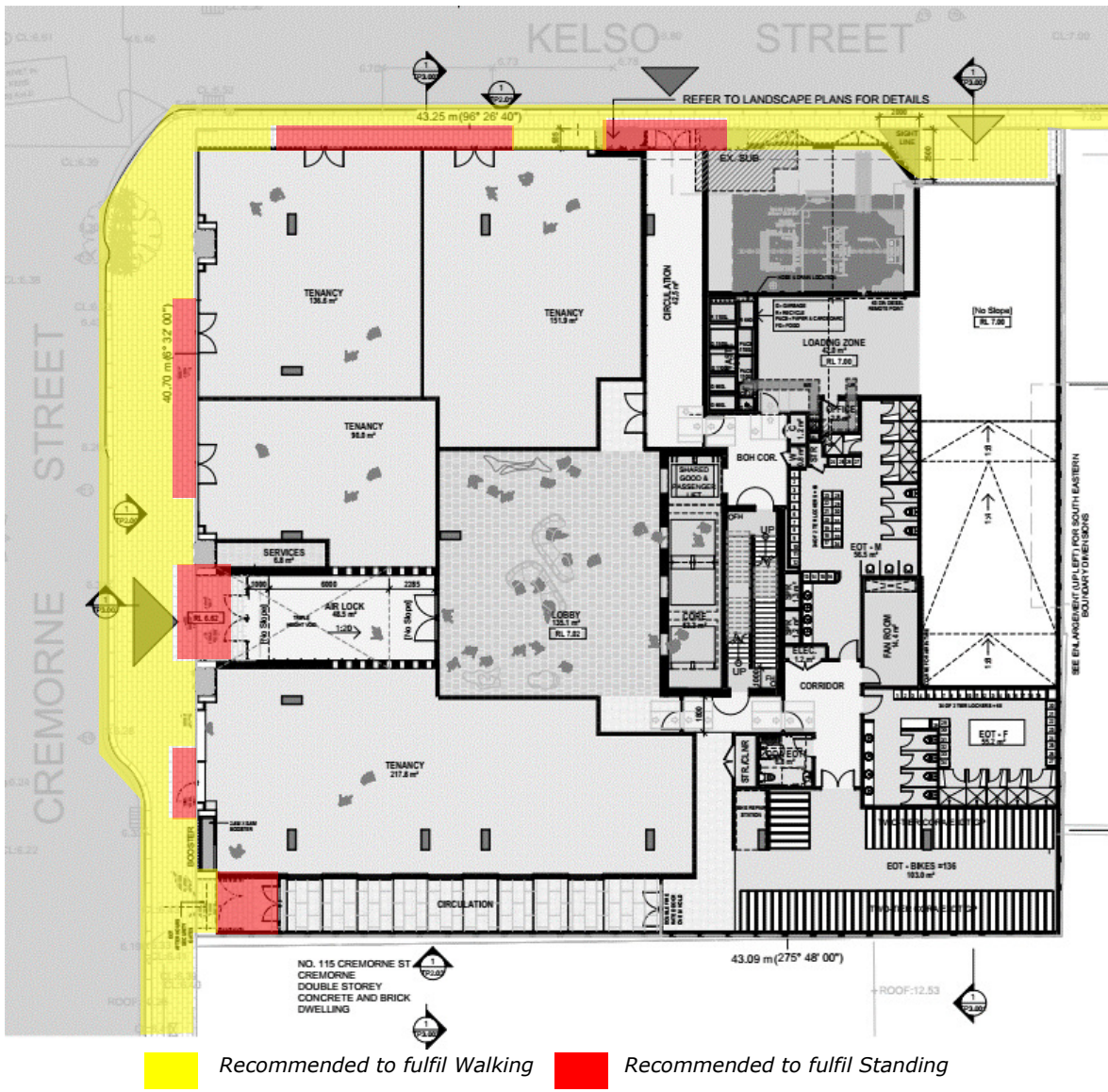


Figure 8: Ground floor with recommended wind criteria overlaid.

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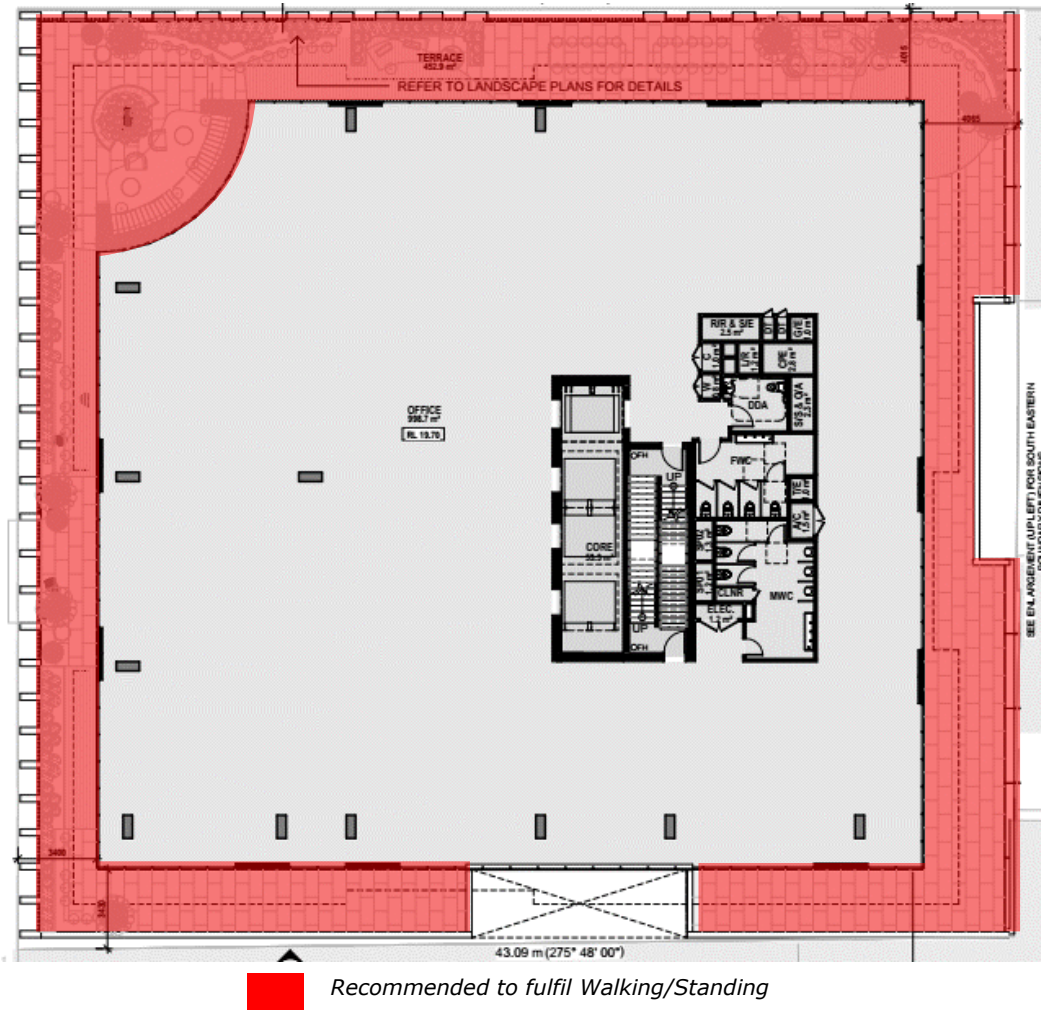


Figure 9: Level 03 plan with recommended wind criteria overlaid.

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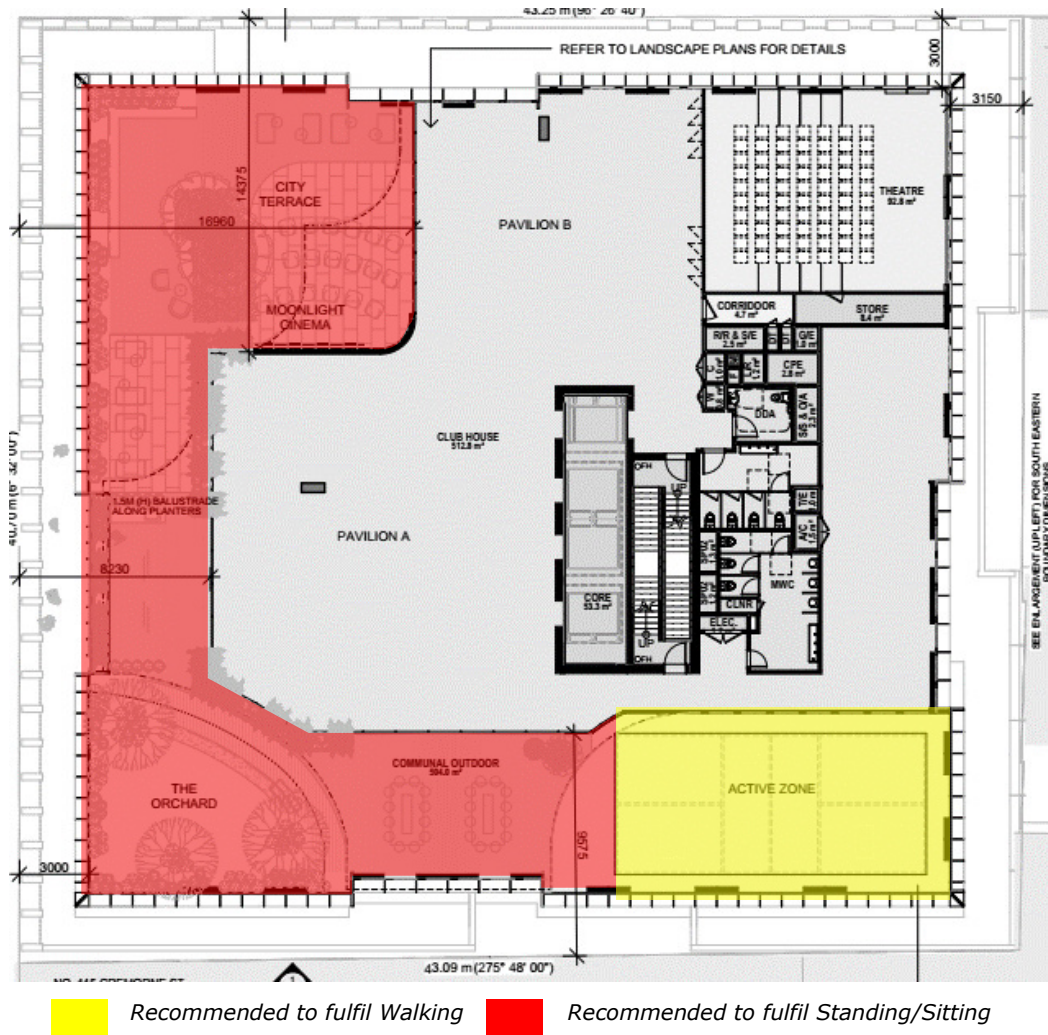


Figure 10: Level 09 plan with recommended wind criteria overlaid.

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■ Recommended to fulfil Standing

Figure 11: Level 10 plan with recommended wind criteria overlaid.

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Recommended to fulfil Standing

Figure 12: Level 11 plan with recommended wind criteria overlaid

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## 3 Pedestrian Level Wind Effects

### 3.1 Discussion & Recommendations

The proposed design has a number of features that are expected to be beneficial to the pedestrian wind environment. This is inclusive but not limited to the following:

- Tower set back from all boundaries;
- Main entrances setback; and
- Landscaping along Cremorne Street and open terraces at different levels.

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#### **Ground Level**

Due to the proposed height above the surrounding areas, the proposed development is particularly exposed to adverse northerly and westerly winds. Such that high wind levels are expected along the two streetscapes and the northern corner. However, the proposed development has a setback tower design from level 3 upwards. These tower setbacks, in combination with the ground level landscaping, are expected to be beneficial to the wind environment on the ground floor. Such that the surrounding pedestrian streetscape is expected to be within the recommended walking comfort criterion.

The main entrances are located at Cremorne Street and Kelso Street. All these entrances are setback from the streetscape by its articulated façade. Such that these entrances are expected to be within the recommended standing comfort criterion or better.

Other entrances into the ground level tenancies are located away from building corners or shielded by raised planters and vegetations. As such all entrances on the ground level are expected to have wind levels within the recommended standing comfort criterion.

#### **Terraces**

Due to the height of the terraces above the surrounding area, the large terraces on level 3, Level 9 to Level 11 are expected to experience high winds. However, in consideration of the landscaping proposed (Figure 13) the wind levels are expected to meet the standing comfort criterion in most areas.

The level 3 terrace features porous balustrades and an under croft on the northern corner. Downwash winds and corner acceleration wind flows through the under croft are expected to be the main drivers of adverse wind conditions on this level. However, given the extent, height and strategic position of the raised planters, most areas on the level 3 terrace are expected to experience wind speeds within the recommended standing comfort criterion. The proposed seating areas on level 3 are expected to have wind levels within the sitting comfort criterion. Some more exposed locations on the building edges are expected to experience wind levels exceeding the recommended wind comfort criterion of standing. However given the offering of many more sheltered areas, this is deemed to be acceptable.

Level 9 of the proposed development features extensive outdoor amenity offerings from a 'moonlight cinema', and 'orchard' to communal outdoor dining areas. The scalloped façade height on this level varies from the lowest at 1.5m high at the northern and western corners to beyond 4.2m at the eastern and southern corners (Figure 14). Given the orientation of the building, this level is somewhat shielded from south westerly winds; however high uninterrupted northerly winds are expected to channel between the building elements that may cause localised adverse wind flows. However, in consideration of the proposed landscaping plans, the strategically placed planters and the set-in nature of the seating areas; all amenity areas on this level are expected to measure wind speeds within the standing comfort criterion. More wind sensitive areas such as the Moonlight Cinema, BBQ areas and Communal outdoor areas on this level are expected to meet the more stringent sitting comfort criterion.

The level 10 terrace level features 1.5m high balustrades, extensive landscaping and arbour structures above outdoor dining areas. Given the size and extent of this upper terrace; we expect that the wind levels will be within the recommended standing comfort criterion.

Similarly, the level 11 Sky Terrace features extensive landscaping and planters. Given the limited extent and size of this terrace; we expect that the wind levels will be within the recommended standing comfort criterion.

Given the complex nature and extent of outdoor amenity offerings on this development; Vipac recommends a wind tunnel test or equivalent computational fluid dynamics study be conducted to quantify the wind conditions and determine the proper wind control measures wherever necessary.

The wind conditions are expected to fulfil safety criterion.

It should be noted that this study is based on experience only and has not utilised any experimental data for the analysis.

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Figure 13: Proposed landscaping plans on Level 3, 9 and 10.

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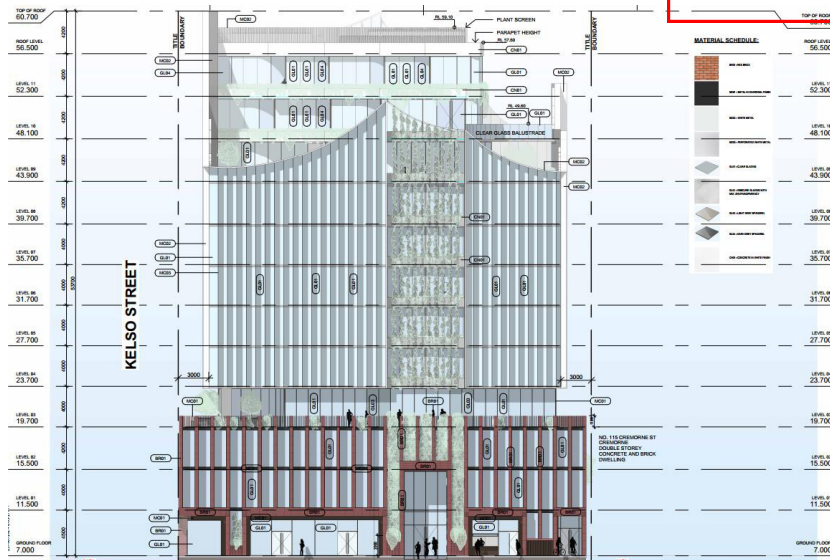


Figure 14: Western elevation of the proposed development

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## 4 Conclusions

An appraisal of the likely wind conditions at the pedestrian ground level and terrace areas of the proposed development at **101 Cremorne Street, Cremorne** has been made.

Vipac has carefully considered the form and exposure of the proposed development, nominated criteria for various public areas according to their function and referred to past experience to produce our opinion of likely wind conditions.

The findings of this study can be summarised as follows:

### With proposed design:

- Wind conditions in the ground level footpath areas and access ways would be expected to be within the **walking** comfort criterion.
- the main entrances would be expected to be within the **standing** comfort criterion;
- The seated areas at the southwest corner would be expected to fulfil **sitting** criterion.
- The terraces and balconies would be expected to be within the recommended **standing** comfort criterion at most areas.
- The wind conditions are expected to fulfil **safety** criterion.

As a general statement, educating occupants about wind conditions at open terrace/balcony areas during high-wind events and fixing loose, lightweight furniture on the terrace are highly recommended.

The assessments provided in this report have been made based on experience of similar situations in Melbourne and around the world. As with any opinion, it is possible that an assessment of wind effects based on experience and without experimental validation may not account for all complex flow scenarios in the vicinity.

Vipac recommends a wind tunnel study be conducted at the detail design stage to quantify the wind conditions and determine the proper wind control measures wherever necessary.

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*This Report has been Prepared*

*For*

*101CSC Pty Ltd ATF 101 CSC Sub Trust c/- Bayley Stuart Capital Pty Ltd*

*By*

*VIPAC ENGINEERS & SCIENTISTS PTY LTD.*

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## Appendix A Environmental Wind Effects

### Atmospheric Boundary Layer

As wind flows over the earth it encounters various roughness elements and terrain such as water, forests, houses and buildings. To varying degrees, these elements reduce the mean wind speed at low elevations and increase air turbulence. The wind above these obstructions travels with unattenuated velocity, driven by atmospheric pressure gradients. The resultant increase in wind speed with height above ground is known as a wind velocity profile. When this wind profile encounters a tall building, some of the fast-moving wind at upper elevations is diverted down to ground level resulting in local adverse wind effects.

The terminology used to describe the wind flow patterns around the proposed development is based on the aerodynamic mechanism, direction and nature of the wind flow.

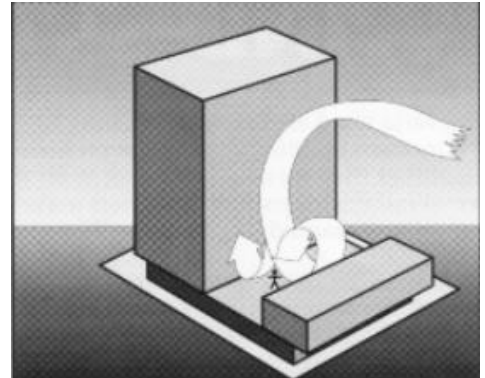
**Downwash** – refers to a flow of air down the exposed face of a tower. A tall tower can deflect a fast-moving wind at higher elevations downwards.

**Corner Accelerations** – when wind flows around the corner of a building it tends to accelerate in a similar manner to airflow over the top of an aeroplane wing.

**Flow separation** – when wind flowing along a surface suddenly detaches from that surface and the resultant energy dissipation produces increased turbulence in the flow. Flow separation at a building corner or at a solid screen can result in gusty conditions.

**Flow channelling** – the well-known “street canyon” effect occurs when a large volume of air is funnelled through a constricted pathway. To maintain flow continuity the wind must speed up as it passes through the constriction. Examples of this might occur between two towers, in a narrowing street or under a bridge.

**Direct Exposure** – a location with little upstream shielding for a wind direction of interest. The location will be exposed to the unabated mean wind and gust velocity. Piers and open water frontage may have such exposure.



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## Appendix B    References

- [1]    *Structural Design Actions, Part 2: Wind Actions*, Australian/New Zealand Standard 1170.2:2011
- [2]    *Wind Effects on Structures* E. Simiu, R Scanlan, Publisher: Wiley-Interscience
- [3]    *Architectural Aerodynamics* R. Aynsley, W. Melbourne, B. Vickery, Publisher: Applied Science Publishers

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## Appendix C Drawings List

Drawings Received: **June 2024**

TP0.00	COVER SHEET
TP0.01	SITE PLAN EXISTING
TP0.02	EXISTING & DEMOLITON PLAN
TP0.03	SITE PLAN PROPOSED
TP1.01	LEVEL B2
TP1.02	LEVEL B1
TP1.03	LEVEL 00
TP1.04	LEVEL 01
TP1.05	LEVEL 02
TP1.06	LEVEL 03
TP1.07	LEVEL 04
TP1.08	LEVEL 05
TP1.09	LEVEL 06
TP1.10	LEVEL 07
TP1.11	LEVEL 08
TP1.12	LEVEL 09
TP1.13	LEVEL 10
TP1.14	LEVEL 11
TP1.15	ROOF LEVEL
TP2.00	WEST ELEVATION - CREMORNE ST
TP2.01	NORTH ELEVATION - KELSO ST
TP2.02	EAST ELEVATION
TP2.03	SOUTH ELEVATION
TP3.001	Section A
TP3.002	Section B
TP3.003	Section C

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